DIRECT TESTIMONY OF
JAMES W. NEELY, P.E.
ON BEHALF OF
DOMINION ENERGY SOUTH CAROLINA, INC.
DOCKET NO. 2019-226-E

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is James W. Neely and my business address is 220 Operation Way, Cayce, South Carolina.

Q. BY WHOM ARE YOU EMPLOYED AND IN WHAT CAPACITY?

A. I am employed by Dominion Energy South Carolina, Inc. ("DESC" or the "Company") as a Senior Resource Planning Engineer.

Q. PLEASE DESCRIBE YOUR DUTIES RELATED TO RESOURCE PLANNING IN YOUR CURRENT POSITION.

A. I am responsible for modeling DESC's electric system for the purpose of calculating avoided costs, determining the least cost resource plan, forecasting fuel costs, and evaluating changes to electric generation.

Q. DESCRIBE YOUR EDUCATIONAL BACKGROUND AND PROFESSIONAL EXPERIENCE.

A. In 1984 I graduated from Clemson University with a Bachelor of Science degree in electrical engineering. I received a Master of Science degree in management from Southern Wesleyan University in 2002. I received a Bachelor of Science degree from Mars Hill University in 1979. I was employed by SCE&G as a design engineer at V.C. Summer Station from 1992 to 1997. In 1997 I went to work in the SCE&G Resource Planning department as a Resource Planning Engineer. In 2013 I was promoted to Senior Resource Planning Engineer.

Q. HAVE YOU PREVIOUSLY TESTIFIED BEFORE THE PUBLIC SERVICE COMMISSION OF SOUTH CAROLINA ("COMMISSION")?

A. Yes.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. The purpose of my testimony is to discuss the resource plans that were analyzed in the DESC 2020 Integrated Resource Plan ("IRP").

Q. HOW IS YOUR TESTIMONY ORGANIZED?

A. My testimony is organized into four sections.

1. Resources used in the resource plans
2. Resource plans that were modeled
3. Sensitivities and assumptions
4. Results

RESOURCES

Q. WHAT RESOURCES WERE MODELED IN THE EIGHT RESOURCE PLANS?

A. Six different resources were modeled and are listed below in Table 1. Please note that "CC" is shorthand for Combined Cycle, "ICT" is shorthand for Internal Combustion Turbine, and "PPA" is shorthand for Power Purchase Agreement. These six resources plus various retirements provide a portfolio of resources that enabled the modeling of a range of supply side resource plans that meet the requirements of Act No 62.

Table 1

Description of Potential Resources

Description of Potential Resources	Capital Cost 2020 $/kW	Escalation Rate	Capacity
Battery Storage	$1,911	-2.463%	100 MW with 4 hour duration
Solar	$1,151	-1.498%	50, 100 or 400 MW
CC 1-on-1	$1,330	3.75%	553 MW
ICT Frame J (2x)	$469	3.75%	523 MW
ICT Aero (2x)	$918	3.75%	131 MW
Solar PPA	N/A	N/A	400 MW

The six resources represent the reasonable range of fuel types or technologies currently available for providing additional generation to DESC customers and economical configurations for those resources.

Q. WHY ARE THE TWO ICT RESOURCES LISTED AS "2X?"

A. The economies of scale benefit adding these simple cycle gas resources in pairs. The MW value listed is for the sum of the two units.

Q. WHAT IS THE SOURCE OF THE DATA FOR THE CAPITAL COST, ESCALATION RATE AND OPERATING CHARACTERISTICS OF THESE TECHNOLOGIES?

A. The capital costs and operating characteristics for the utility-owned resources listed above were provided by Dominion Energy Services Generation Construction Financial Management and Controls Group. This group routinely monitors the generation technology available for acquisition by Dominion Energy subsidiaries, including Dominion Energy public utilities subsidiaries, merchant power subsidiaries and renewable energy subsidiaries. Capital escalation assumptions for natural gas-fired resources are as reported in the Handy Whitman Index of Public Utility Construction Costs which is the leading index of its type throughout the industry. Capital escalation assumptions for solar and storage resources are as reported by the National Renewable Energy Laboratory ("NREL"), a source of information related to the economics and development of renewable resources.

Q. DESCRIBE THE RESOURCES THAT WERE MODELED IN THE EIGHT RESOURCE PLANS?

A. Battery storage can be a system resource or a renewable resource. If it is a system resource, it can be charged by any resource. If it is a renewable resource, then it can only be charged by a renewable generator. The Battery resource that was modeled had a four-hour duration and a 2% per year degradation with a 95% efficiency.

Solar is modeled using an hourly profile consistent with a single axis tracking solar system with an average annual capacity factor of 23.8%. If the solar is not designated as Solar PPA, then it is assumed to be utility owned and its only cost is the capital cost. If solar is designated as a PPA, then it has a $/KW-month cost calculated using the NREL data but no other cost. All solar is modeled as flexible solar which means it is available to be dispatched down to zero megawatt (MW) and it can also provide up reserves.

The gas resources modeled include a combined cycle gas generation modeled as a 1-on-1 ("CC 1-on-1") system of 553 MW winter capacity, 534 MW summer capacity and a full load winter heat rate of 6554 Btu/KWh. A CC 1-on1 generator is a single internal combustion turbine paired with a single heat recovery boiler and a single steam turbine. Two types of standalone ICT gas generators were modeled. The first was a heavy frame ICT ("ICT Frame J") modeled using the characteristics of two gas turbines with a total winter capacity of 523 MW and a full load winter heat rate of 9364 Btu/KWh. The second type of standalone ICT technology was modeled using the characteristics of two aero-derivatives ("ICT Aero") with a total winter capacity of 131 MW and a full load winter heat rate of 9131 Btu/KWh.

RESOURCE PLANS

Q. WHAT WAS THE METHODOLOGY USED TO DEVELOP THE RESOURCE PLANS MODELED IN THE IRP?

A. A collection of generation resources and technologies was identified with the purpose of fairly evaluating a range of supply-side resources that are currently available to meet the utility's service obligations. These included storage, utility and third-party owned solar, and CC and ICT gas turbine resources referenced above. Reasonable scenarios for the early retirement of some generation facilities were also identified. These resources and assumptions concerning facility retirements were combined into eight potential resource plans. Next a set of low, medium and high demand side scenarios was identified that included customer energy efficiency and demand response programs as discussed by Company Witnesses Bell and Griffin. The base load forecast combined with each of the three demand side management ("DSM") scenarios created three forecasts of summer and winter peaks. Using the peak forecasts, the eight groups of resources were configured and resource additions were scheduled to ensure that DESC could meet its reserve margin requirements in summer and winter of each year. These resulting schedules of resource additions produced the eight resource plans that were modeled.

Q. DESCRIBE HOW THE DESC RESERVE MARGIN POLICY IS APPLIED?

A. DESC's reserve margin policy is summarized below in Table 2.

Table 2

DESC's Reserve Margin Policy

	Summer	Winter
Base Reserves	**12%**	**14%**
Peaking Reserves	**14%**	**21%**
Increment for Peaking	**2%**	**7%**

The planning criteria includes both base reserves and peaking reserves. Base reserves are the reserves needed to meet system requirements in all but the five highest peak load days in the winter or summer season. Incremental peaking reserves are the additional capacity above the base reserves needed to provide the required level of reserves during those five peak load days. For the summer months which include May through October, DESC requires base reserves in the amount of 12% of the summer peak load to operate the system reliably and 14% of summer peak load during the peak load periods. For the winter months of November through April, DESC requires 14% of the winter peak load forecast in base reserves to operate the system reliably and 21% for the peak load periods.

Base resources are the long-term resources explicitly identified in a resource plan's 40-year schedule to meet the summer or winter base reserve margin. For the purpose of resource planning, the peaking reserve margin is not the criteria used for adding long term capacity resources in the eight resource plans. Incremental peaking reserves are modeled as short-term winter capacity purchases, although they may be met in a variety of ways such as demand response programs, upgrading existing peaking resources, or capacity purchases. The winter base and peaking reserve margins were the constraining factors used to determine the timing of adding all generation resources in the eight resource plans.

Q. WHAT RESOURCE PLANS WERE CONSIDERED IN THE IRP?

A. The eight resource plans are described in Table 3 below, which is taken from the IRP, and discussed in more detail below. These resource plans were chosen with the purpose of fairly evaluating a range of supply-side resources that included, storage, renewable energy, facility retirement assumptions and gas technologies that could meet the utility's service obligations.

Table 3

Description of Resource Plans

Resource Plan ID	Resource Plan Name	Resource Plan Description
RP1	CC	Combined Cycle, ICTs
RP2	ICT	ICTs
RP3	Retire Wateree	Wateree 1 & 2 retirement, Combined Cycle, ICTs
RP4	Retire McMeekin	McMeekin and Urquhart 3 retirement, ICTs
RP5	Solar + Storage	Flexible Solar + Battery Storage, Combined Cycle, ICTs
RP6	Solar	Flexible Solar, ICTs
RP7	Solar PPA + Storage	Flexible Solar PPA + Battery Storage, ICTs
RP8	Retire Coal	Replace Wateree and Williams with Combined Cycle, Solar and Battery Storage, ICTs

Resource Plan 1: In this resource plan, a CC 1-on-1 unit is added when the winter reserve margin drops below 14% which occurs in 2035 in the Medium DSM case. This unit is a high efficiency natural gas-fired CC 1-on-1 generator consisting of a single combustion turbine combined with a single steam turbine. It produces 553 MW (winter capacity) and is very fuel efficient with a full load winter heat rate of only 6554 Btu/KWh. Five hundred twenty-three (523) MW blocks of ICT Frame Js are added to maintain the 14% winter reserve margin during the remainder of modeling period.

Resource Plan 2: In this resource plan, a pair of ICT Frame Js are added when the winter reserve margin drops below 14% during the modeling period. In this configuration, two ICT Frame Js are constructed together to lower costs and have an output of 523 MW (winter capacity). While less fuel efficient than a CC 1-on-1, these units are significantly more flexible in operation, and they are more efficient than the existing turbines while costing less to construct than a CC unit.

Resource Plan 3: In this resource plan, Wateree 1 and 2 are retired in 2028 and a CC 1-on-1 unit is added in 2028. Five hundred twenty-three (523) MW blocks of ICT Frame Js are added to maintain the 14% winter reserve margin during the modeling period.

Resource Plan 4: In this resource plan, McMeekin 1 and 2 along with Urquhart 3 are retired in 2028. These units are older coal-fired boiler units that have been converted to natural gas only operation. Their original in-service dates are 1954 and 1958, respectively. Changing out these older units results in higher efficiency, greater operational flexibility, and improved reliability. Under this resource plan, their 346 MW of capacity are replaced by 523 MW of ICT Frame J capacity. Five hundred twenty-three (523) MW blocks of ICT Frame Js are added to maintain the 14% winter reserve margin during the remainder of the modeling period.

Resource Plan 5: In this resource plan, 400 MW of Company owned flexible solar generation plus 100 MW of battery storage are added in 2026. The next increment of capacity necessary to maintain a 14% winter reserve margin is a CC 1-on-1 553 MW generator. After the CC 1-on-1, 523 MW blocks of ICT Frame Js are added to maintain the 14% winter reserve margin during the remainder of modeling period.

Resource Plan 6: In this resource plan, 400 MW of Company owned flexible Solar generation is added in 2026. Five hundred twenty-three (523) MW blocks of ICT Frame Js are added to maintain the 14% winter reserve margin during the remainder of the modeling period.

Resource Plan 7: In this resource plan, 400 MW of flexible solar PPA generation plus 100 MW of battery storage are added in 2026. Five hundred twenty-three (523) MW blocks of ICT Frame Js are added to maintain the 14% winter reserve margin during the remainder of the modeling period.

Resource Plan 8: In this resource plan, Wateree and Williams are retired in 2028 and replaced with a 553 MW CC 1-on-1 and five hundred twenty-three (523) MW of ICT Frame Js. Dual fuel capability is eliminated at Cope, so Cope burns only natural gas starting in 2030. Additional tranches of 100 MW of battery storage and 131 MW ICT Aeros are added to maintain the 14% winter reserve margin during the modeling period. Solar is added in 2026, 2027 and from 2029 to 2048. This resource plan is the low carbon plan.

SENSITIVITIES AND ASSUMPTIONS

Q. WHAT SENSITIVITIES AND ASSUMPTIONS WERE CONSIDERED IN MODELING DESC'S CURRENT RESOURCE PLANS?

A. The sensitivities considered include an evaluation of low, medium, and high cases for the adoption of DSM. Sensitivities also include various levels of renewable energy, fuel costs and environmental regulations. We considered eight assumptions when modeling the resource plans: three levels of DSM, three gas prices forecasts, and two CO_2 prices.

Q. WHAT WERE THE LEVELS OF DSM THAT WERE MODELED?

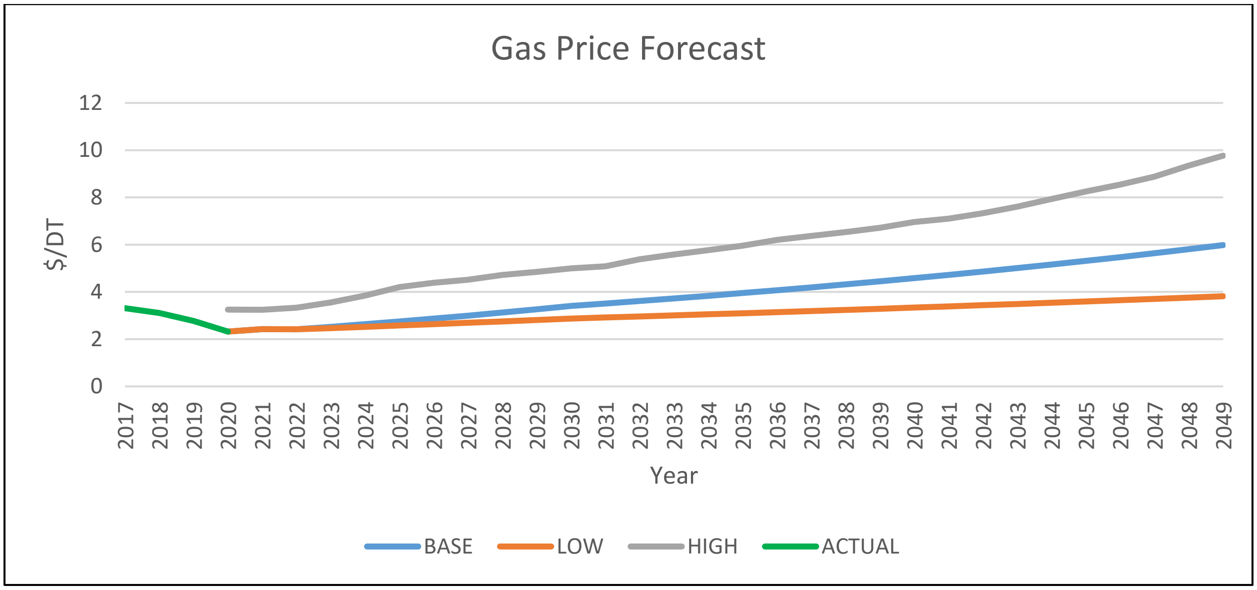
A. Three DSM cases were modeled, low, medium and high. The low DSM is equivalent to DSM programs and levels on the DESC electric system prior to adoption of *Dominion Energy South Carolina: 2020–2029 Achievable DSM Potential and PY10–PY14 Program Plan* (the "2019 Potential Study"). The medium DSM assumes that the energy sales reductions described by the 2019 Potential Study would be fully achieved. The high DSM case assumes that DSM programs reduce annual energy sales by 1% of retail sales by 2022. The high DSM case was not a part of the scope of the DESC 2019 Potential Study. Rather, those savings were scaled using outputs from the low and medium DSM cases combined with the professional judgement of ICF Resources, L.L.C. ("ICF"). Its use here is not supported by any analysis that would establish that a DSM program at that level would be practical and achievable, or cost effective as required by the DSM statute.

The three DSM cases created three demand and energy forecasts. A low DSM case results in demands for capacity and energy that are higher than the other cases. The high DSM case results in demands for capacity and energy that are lower than other cases. The cost for each DSM case was calculated over a 40-year period and applied to the appropriate scenarios. The low and high DSM levels were modeled with zero dollars per ton CO_2 and base gas. Only the medium DSM case was modeled with all three gas prices and both CO_2 prices.

Q. DESCRIBE THE THREE LEVELS OF GAS PRICES THAT WERE MODELED.

A. The chart below shows the three gas price forecasts used. The base gas and low gas scenarios are based on monthly NYMEX gas prices for years 2020-2022 then escalated at two different rates. The base escalation rate is derived from the EIA gas price forecast which is 4.394% until 2032 when it drops to 3.007%. The low gas scenario escalation rate is half of the base gas escalation rate or 2.197% until 2032 and 1.504% after that date. The high gas price forecast is the 2019 EIA gas price forecast and is used for the entire modeling period. The EIA gas forecast has been consistently higher than actual gas prices in recent years.

Low, Base and High Gas Price Forecast



Q. DESCRIBE THE TWO CO_2 PRICES THAT WERE MODELED.

A. The IRP modeled CO_2 prices of zero dollars per ton and twenty-five dollars per ton. The $25/ton CO_2 prices begin in 2025 and grew at 2%/year.

The $25/ton CO_2 price is higher than any currently traded CO_2 prices in the U.S. but clearly captures the risk that CO_2 prices may be higher than anticipated in 2025. In California, CO_2 currently trades at about $15/ton, in Canada $15/ton and in the United Kingdom at $25/ton.

The current structure for regulating CO_2 emissions is Affordable Clean Energy Rule (ACE). Under it, states are required to establish standards of performance for each designated facility within their jurisdiction and submit state plans to EPA for approval by July 8, 2022. Compliance schedules for designated facilities must initiate within 24 months after a state plan submission. Facilities may need additional time to implement plant improvements required by the rule. For these reasons, using 2025 as the start date for CO_2 costs is a reasonable choice.

Q. DESCRIBE HOW RISK AND UNCERTAINTIES WERE ADDRESSED.

A. Risk and uncertainties are addressed through the various sensitives that were modeled along with the variety of resources that made up each of the eight resource plans.

Q. DESCRIBE HOW RELIABILITY WAS ADDRESSED.

A. Reliability is addressed through the careful analysis of the needed reserve margin, and each resource plan has been constructed to meet the reserve margin with reliable dispatchable resources. To maintain reliability, intermittent resources had a reduced contribution to the reserve margin.

Q. DESCRIBE HOW COGENERATION WAS ADDRESSED.

A. Cogeneration projects are highly customer driven and dependent upon the steam user's individual steam requirements and are therefore difficult to accurately model as a generic project. Impact to the DESC system would be dependent on identifying a steam user willing to partner in the project. Both Resource Plan 1 and Resource Plan 2 reasonably represent a cogeneration plan that utilizes the heat produced to create steam for a manufacturing facility since any additional costs would be borne by the steam user.

Q. WHY WEREN'T THE HIGH AND LOW LOAD GROWTH FORECAST SCENARIOS USED IN THE DEVELOPMENT OF RESOURCE PLANS?

A. There are several reasons that the high and low forecast scenarios, described in IRP section I.B., were not studied in the resource planning portion of the IRP. They are:

1. Resource planning included three levels of DSM which caused a change in the energy and peak demands. By analyzing the impact of these changes in load on the resource plans, the Company could anticipate the impact of further changes in load.
2. The resource planning study developed 64 different combinations of scenarios and resource plans which provided sufficient breath of analysis for the IRP.
3. The sensitivities modeled met all the requirements of Act No 62.

RESULTS

Q. HOW WERE PLANS MODELED?

A. PROSYM is a production cost model that executes an hourly time series simulation of the utilities loads and resources. PROSYM modeled the commitment and dispatch of all existing and proposed generating units to serve the load hour-by-hour. The hourly loads used by PROSYM are created from a forecast of twenty years of monthly demands and energies which are escalated to create a thirty-year forecast which is applied to a typical hourly profile. The result is thirty years of hourly load values against which the model dispatched resources.

In each simulation units were dispatched based on economics with must-run, hydro and lowest cost units dispatched first. More expensive units were added until generation resources equaled the projected load. PROSYM maintained all unit constraints such as minimum and maximum capacity, heat rate, ramp rates, minimum and maximum up and down times, forced outages, maintenance outages, fuel constraints, and many other variables. PROSYM considered all unit costs which include fuel costs, variable operation and maintenance costs, fixed operation and maintenance costs, start costs, stop costs and emissions costs. PROSYM also determined all system costs which include system purchase and sales costs.

Q. HOW WERE THE PROSYM OUTPUTS AND OTHER COSTS COMBINED TOGETHER IN THE FINAL ANALYSIS?

A. The PROSYM model created annual operating costs for each scenario which were added to 40 years of capital costs for new generators and 40 years of DSM costs. The 40 years of capital costs are created by first determining the current year capital costs for construction of the new generating facilities. (See Table 1.) The capital costs are then escalated to the installation year of the new generators. These escalated values were used to create a schedule of annual revenue requirements for each generator and includes depreciation, taxes, return on investment and insurance. The annual revenue requirements for each generator are summed by year and added to the PROSYM created operating costs. Annual DSM costs are then added to get the annual total costs for years 2020 through 2059. From the 2020 through 2059 annual costs we calculate a levelized net present value ("NPV"). The levelized NPV is used to rank each resource plan. See Tables 4 and 5 for the resource plan rankings.

Q. HOW DOES DSM SENSITIVITY AFFECT THE RESULTS?

A. All three DSM sensitivities were modeled with zero CO_2 costs and base gas. Resource Plan 2 is the lowest cost resource plan for all levels of DSM modeled. Three of the other seven resource plans had low NPV costs in at least one of the three DSM cases. See Table 4. (1 – Green = Least cost, 2 – Blue = Second Lowest and 8 - Orange = Highest cost)

Table 4
Resource Plan Rankings by Levelized NPV for Low, Medium and High DSM

Resource Plan ID	Resource Plan Name	Low DSM	Medium DSM	High DSM
RP1	CC	6	5	4
RP2	ICT	1	1	1
RP3	Retire Wateree	2	6	6
RP4	Retire McMeekin	5	3	5
RP5	Solar + Storage	8	7	8
RP6	Solar	4	4	2
RP7	Solar PPA + Storage	3	2	3
RP8	Retire Coal	7	8	7

Q. HOW DO RETIREMENTS AFFECT THE RESULTS?

A. Three of the eight resource plans contained early retirements. Modeling different retirement scenarios allows us to get a sense of the cost and value of retirements as well as their impact on CO_2 emissions.

Q. HOW DO VARYING GAS PRICES AFFECT THE RESULTS?

A. When the other sensitivities are held constant, changing the gas prices did not cause a dramatic change in the results. Retiring coal plants remained expensive under all three gas prices. Resource Plan 7 (Solar + Storage) went from third least cost under low gas prices to least cost under high gas prices. No resource plan moved more than two rankings under the three gas prices scenarios. See Table 5 below.

Table 5

Resource Plan Levelized NPV Rankings for Medium DSM

Resource Plan ID	Resource Plan Name	\$0/ton CO_2, Low Gas	\$0/ton CO_2, Base Gas	\$0/ton CO_2, High Gas	\$25/ton CO_2, Low Gas	\$25/ton CO_2, Base Gas	\$25/ton CO_2, High Gas
RP1	CC	6	5	5	7	6	6
RP2	ICT	1	1	2	3	4	3
RP3	Retire Wateree	5	6	7	4	3	5
RP4	Retire McMeekin	2	3	4	6	7	8
RP5	Solar + Storage	8	7	6	8	8	7
RP6	Solar	4	4	3	5	5	4
RP7	Solar PPA + Storage	3	2	1	2	2	2
RP8	Retire Coal	7	8	8	1	1	1

Q. HOW DO VARYING CO_2 PRICES AFFECT THE RESULTS?

A. As can be seen in Table 5, changing the CO_2 price had little effect on the resource plan rankings with one exception. Resource Plan 8 changed its ranking from eight (most expensive) to one (least expensive) when a CO_2 price was introduced. Resource Plan 8 eliminates all use of coal for fuel by year 2030.

Q. WHAT ARE THE RESULTS OF YOUR ANALYSIS?

A. Important results in the Resource Plan Analysis include that Resource Plan 2 was the least cost plan under all DSM cases where the modeling reflects base gas prices and \$0/ton CO_2, though the cost difference between all cases was modest. Resource Plan 8 resulted in the least carbon impact under all scenarios. All resource plans include the addition of combustion turbines or combined cycle plants but Resource Plans 5, 6, 7 and 8 also add renewables. Resource Plan 2 which adds only combustion turbines, Resource Plan 7 which has solar with storage, and Resource Plan 8 which retires coal, rank the least cost depending upon the sensitivity selection. Resource Plan 8 has the lowest 2030 CO_2 emissions by a significant margin, and the lowest cost in some scenarios. All resource plans had similar levelized NPV costs when the assumptions about DSM, CO_2 and gas were held constant. These differences indicate that the relative rankings could change based on updated information in the future. While the Company makes observations and conclusions as to which resource plan results in the least cost, the results do not reflect a decision by the Company for its path forward.

Q. DOES THIS CONCLUDE YOUR DIRECT TESTIMONY?

A. Yes.